

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:
  - a first converter configured to convert a first  
5 digital audio signal sampled with a predetermined audio  
sampling frequency for digital audio into a second digital  
audio signal sampled with a predetermined voice sampling  
frequency for voice signals;
  - a second converter configured to convert a first  
10 digital voice signal sampled with the predetermined voice  
sampling frequency into a second digital voice signal  
sampled with the predetermined audio sampling frequency;
  - a first digital processor configured to perform a  
predetermined digital computation on the second digital  
15 audio signal sampled with the predetermined voice sampling  
frequency and a digital voice signal; and
  - a second digital processor configured to perform the  
predetermined digital computation on the second digital  
voice signal sampled with the predetermined audio sampling  
20 frequency and the first digital audio signal sampled with  
the predetermined audio sampling frequency.

2. The semiconductor device according to Claim 1,  
wherein the predetermined digital computation includes an

addition, a subtraction, a rate setting of the addition, and  
a rate setting of the subtraction.

3. The semiconductor device according to Claim 1,  
5 wherein the first digital processor performs a volume  
setting on a digital signal processed with the predetermined  
digital computation.

4. The semiconductor device according to Claim 1,  
10 wherein the first digital processor performs a signal band  
limitation on a digital signal processed with the  
predetermined digital computation.

5. The semiconductor device according to Claim 4,  
15 wherein the signal band limitation is pre-programmable.

6. The semiconductor device according to Claim 1,  
wherein the second digital processor performs a volume  
setting on a digital signal processed with the predetermined  
20 digital computation.

7. The semiconductor device according to Claim 1,  
wherein the second digital processor performs a signal band  
limitation on a digital signal processed with the

predetermined digital computation.

8. The semiconductor device according to Claim 7,  
wherein the signal band limitation is pre-programmable.

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9. A mobile phone using a semiconductor device,  
comprising:

an input device configured to convert a voice into an  
analog voice signal;

10 a voice analog-to-digital converter configured to  
convert the analog voice signal output from said input  
device into a first digital voice signal;

a voice digital-to-analog converter configured to  
convert a second digital voice signal sampled with a  
15 predetermined voice sampling frequency for voice signals  
into an analog voice signal;

a voice output device configured to generate a voice  
sound in accordance with the analog voice signal output from  
said voice digital-to-analog converter;

20 an audio digital-to-analog converter configured to  
convert a digital audio signal sampled with a predetermined  
audio sampling frequency for audio signals into an analog  
audio signal; and

an audio output device configured to generate an audio

sound in accordance with the analog audio signal output from said audio digital-to-analog converter,

wherein the semiconductor device is configured to process the digital voice signal, the digital voice signal  
5 sampled with the predetermined voice sampling frequency, and the digital audio signal sampled with the predetermined audio sampling frequency, and comprises:

a first converter configured to convert the digital audio signal into a first converted signal sampled with the  
10 predetermined voice sampling frequency;

a second converter configured to convert the digital voice signal into a second converted signal sampled with the predetermined audio sampling frequency;

a first digital processor configured to perform a  
15 predetermined digital computation on the digital audio signal sampled with the predetermined voice sampling frequency and the first digital voice signal; and

a second digital processor configured to perform the predetermined digital computation on the second digital  
20 voice signal sampled with the predetermined audio sampling frequency and the digital audio signal sampled with the predetermined audio sampling frequency.

10. The mobile phone according to Claim 9, wherein

the predetermined digital computation includes an addition, a subtraction, a rate setting of the addition, and a rate setting of the subtraction.

5           11.    The mobile phone according to Claim 9, wherein the first digital processor performs a volume setting on a digital signal processed with the predetermined digital computation.

10           12.    The mobile phone according to Claim 9, wherein the first digital processor performs a signal band limitation on a digital signal processed with the predetermined digital computation.

15           13.    The mobile phone according to Claim 12, wherein the signal band limitation is pre-programmable.

            14.    The mobile phone according to Claim 9, wherein the second digital processor performs a volume setting on a  
20 digital signal processed with the predetermined digital computation.

            15.    The mobile phone according to Claim 9, wherein the second digital processor performs a signal band

limitation on a digital signal processed with the  
predetermined digital computation.

16. The mobile phone according to Claim 15, wherein  
5 the signal band limitation is pre-programmable.

17. A mobile phone using a semiconductor device,  
comprising:

an input device configured to convert a voice into an  
10 analog voice signal;

a voice analog-to-digital converter configured to  
convert the analog voice signal output from said input  
device into a first digital voice signal;

a digital voice amplifier configured to amplify and  
15 output a second digital voice signal sampled with a  
predetermined voice sampling frequency for voice signals;

a voice output device configured to generate a voice  
sound in accordance with the second digital voice signal  
output from said digital voice amplifier;

20 a digital audio amplifier configured to amplify and  
output a digital audio signal sampled with a predetermined  
audio sampling frequency for an audio signal;

an audio output device configured to generate an audio  
sound in accordance with the digital audio signal output

from said digital audio amplifier,

wherein the semiconductor device is configured to process the first digital voice signal, the second digital voice signal sampled with the predetermined voice sampling  
5 frequency, and the digital audio signal sampled with the predetermined audio sampling frequency, and comprises:

a first converter configured to convert the digital audio signal into a signal sampled with the predetermined voice sampling frequency;

10 a second converter configured to convert the first digital voice signal into a signal sampled with the predetermined audio sampling frequency;

a first digital processor configured to perform a predetermined digital computation on the digital audio  
15 signal sampled with the predetermined voice sampling frequency and the digital voice signal; and

a second digital processor configured to perform the predetermined digital computation on the first digital voice signal sampled with the predetermined audio sampling  
20 frequency and the digital audio signal sampled with the predetermined audio sampling frequency.

18. A semiconductor device comprising:

first converting means for converting a first digital

audio signal sampled with a predetermined audio sampling frequency for digital audio into a second digital audio signal sampled with a predetermined voice sampling frequency for voice signals;

5           second converting means for converting a first digital voice signal sampled with the predetermined voice sampling frequency into a second digital voice signal sampled with the predetermined audio sampling frequency;

          first digital processing means for performing a  
10 predetermined digital computation on the second digital audio signal sampled with the predetermined voice sampling frequency and a third digital voice signal; and

          second digital processing means for performing the predetermined digital computation on the second digital  
15 voice signal sampled with the predetermined audio sampling frequency and the first digital audio signal sampled with the predetermined audio sampling frequency.

19.   The semiconductor device according to Claim 18,  
20 wherein the predetermined digital computation includes an addition, a subtraction, a rate setting of the addition, and a rate setting of the subtraction.

20.   The semiconductor device according to Claim 18,



wherein the first digital processing means performs a volume setting on a digital signal processed with the predetermined digital computation.

5           21.    The semiconductor device according to Claim 18,  
              wherein the first digital processing means performs a signal  
              band limitation on a digital signal processed with the  
              predetermined digital computation.

10           22.    The semiconductor device according to Claim 21,  
              wherein the signal band limitation is pre-programmable.

              23.    The semiconductor device according to Claim 18,  
              wherein the second digital processing means performs a  
15           volume setting on a digital signal processed with the  
              predetermined digital computation.

              24.    The semiconductor device according to Claim 18,  
              wherein the second digital processing means performs a  
20           signal band limitation on a digital signal processed with  
              the predetermined digital computation.

              25.    The semiconductor device according to Claim 21,  
              wherein the signal band limitation is pre-programmable.

26. A mobile phone using a semiconductor device, ,  
comprising:

input means for converting a voice into an analog  
5 voice signal;

analog-to-digital voice converting means for  
converting the analog voice signal output from said input  
means into a first digital voice signal;

digital-to-analog voice converting means for  
10 converting a second digital voice signal sampled with a  
predetermined voice sampling frequency for voice signals  
into an analog voice signal;

voice output means for generating a voice sound in  
accordance with the analog voice signal output from said  
15 digital-to-analog voice converting means;

digital-to-analog audio converting means for  
converting a digital audio signal sampled with a  
predetermined audio sampling frequency for audio signals  
into an analog audio signal; and

20 audio output means for generating an audio sound in  
accordance with the analog audio signal output from said  
digital-to-analog audio converting means,

wherein the semiconductor device is configured to  
process the first digital voice signal, the second digital

voice signal sampled with the predetermined voice sampling frequency, and the digital audio signal sampled with the predetermined audio sampling frequency, and comprises:

5           first converting means for converting the digital audio signal into a signal sampled with the predetermined voice sampling frequency;

          second converting means for converting the first digital voice signal into a signal sampled with the predetermined audio sampling frequency;

10           first digital processing means for performing a predetermined digital computation on the digital audio signal sampled with the predetermined voice sampling frequency and the second digital voice signal; and

          second digital processing means for performing  
15       the predetermined digital computation on the first digital voice signal sampled with the predetermined audio sampling frequency and the digital audio signal sampled with the predetermined audio sampling frequency.

20           27.   The mobile phone according to Claim 26, wherein the predetermined digital computation includes an addition, a subtraction, a rate setting of the addition, and a rate setting of the subtraction.

28. The mobile phone according to Claim 26, wherein  
the first digital processing means performs a volume setting  
on a digital signal processed with the predetermined digital  
5 computation.

29. The mobile phone according to Claim 26, wherein  
the first digital processing means performs a signal band  
limitation on a digital signal processed with the  
10 predetermined digital computation.

30. The mobile phone according to Claim 29, wherein  
the signal band limitation is pre-programmable.

15 31. The mobile phone according to Claim 26, wherein  
the second digital processing means performs a volume  
setting on a digital signal processed with the predetermined  
digital computation.

20 32. The mobile phone according to Claim 26, wherein  
the second digital processing means performs a signal band  
limitation on a digital signal processed with the  
predetermined digital computation.

33. The mobile phone according to Claim 32, wherein the signal band limitation is pre-programmable.

34. A mobile phone using a semiconductor device,  
5 comprising:

input means for converting a voice into an analog voice signal;

analog-to-digital voice converting means for converting the analog voice signal output from said input  
10 means into a first digital voice signal;

digital voice amplifying means for amplifying and outputting a second digital voice signal sampled with a predetermined voice sampling frequency for voice signals;

voice output means for generating a voice sound in  
15 accordance with the second digital voice signal output from said digital voice amplifying means;

digital audio amplifying means for amplifying and outputting a digital audio signal sampled with a predetermined audio sampling frequency for audio signals;

20 audio output means for generating an audio sound in accordance with the digital audio signal output from said digital audio amplifying means,

wherein the semiconductor device is configured to process the first digital voice signal, the second digital

voice signal sampled with the predetermined voice sampling frequency, and the digital audio signal sampled with the predetermined audio sampling frequency, and comprises:

5           first converting means for converting the digital audio signal into a signal sampled with the predetermined voice sampling frequency;

          second converting means for converting the first digital voice signal into a signal sampled with the predetermined audio sampling frequency;

10           first digital processing means for performing a predetermined digital computation on the digital audio signal sampled with the predetermined voice sampling frequency and the second digital voice signal; and

          second digital processing means for performing  
15           the predetermined digital computation on the first digital voice signal sampled with the predetermined audio sampling frequency and the digital audio signal sampled with the predetermined audio sampling frequency.

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35.   A method of providing a semiconductor device comprising the steps of:

          first converting a first digital audio signal sampled with a predetermined audio sampling frequency for digital

audio into a second digital audio signal sampled with a predetermined voice sampling frequency for voice signals;

second converting a first digital voice signal sampled with the predetermined voice sampling frequency into a  
5 second digital voice signal sampled with the predetermined audio sampling frequency;

first digital processing of the second digital audio signal sampled with the predetermined voice sampling frequency and a third digital voice signal with a  
10 predetermined digital computation; and

second digital processing of the second digital voice signal sampled with the predetermined audio sampling frequency and the first digital audio signal sampled with the predetermined audio sampling frequency with the  
15 predetermined digital computation.

36. The method according to Claim 35, wherein the predetermined digital computation includes an addition, a subtraction, a rate setting of the addition, and a rate  
20 setting of the subtraction.

37. The method according to Claim 35, wherein the first digital processing further comprises the step of setting volume to a digital signal processed with the

predetermined digital computation.

38. . The method according to Claim 35, wherein the  
first digital processing further comprises the step of  
5 limiting a signal band of a digital signal processed with  
the predetermined digital computation.

39. The method according to Claim 38, wherein the  
limiting step is pre-programmable.

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40. The method according to Claim 35, wherein the  
second digital processing further comprises the step of  
setting volume of a digital signal processed with the  
predetermined digital computation.

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41. The method according to Claim 35, wherein the  
second digital processing further comprises the step of  
limiting a signal band of a digital signal processed with  
the predetermined digital computation.

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42. The method according to Claim 41, wherein the  
limiting step is pre-programmable.

43. A method of mobile telecommunication using a



semiconductor device, comprising the steps of:

first converting a voice input into a first analog voice signal;

second converting the first analog voice signal output  
5 from said converting step into a first digital voice signal;

third converting a second digital voice signal sampled with a predetermined voice sampling frequency for voice signals into a second analog voice signal;

first generating a voice sound in accordance with the  
10 second analog voice signal output from said third converting step;

fourth converting a first digital audio signal sampled with a predetermined audio sampling frequency for audio signals into an analog audio signal; and

15 second generating an audio sound in accordance with the analog audio signal output from said fourth converting step,

wherein the semiconductor device is configured to process the first digital voice signal, the second digital  
20 voice signal sampled with the predetermined voice sampling frequency, and the first digital audio signal sampled with the predetermined audio sampling frequency, and comprises the steps of:

first converting the first digital audio signal

into a second digital audio signal sampled with the predetermined voice sampling frequency;

second converting the first digital voice signal into a signal sampled with the predetermined audio sampling frequency;

first digital processing of the second digital audio signal sampled with the predetermined voice sampling frequency and the second digital voice signal with a predetermined digital computation; and

second digital processing of the first digital voice signal sampled with the predetermined audio sampling frequency and the first digital audio signal sampled with the predetermined audio sampling frequency with the predetermined digital computation.

44. The method according to Claim 43, wherein the predetermined digital computation includes an addition, a subtraction, a rate setting of the addition, and a rate setting of the subtraction.

45. The method according to Claim 43, wherein the first digital processing step further comprises the step of setting a volume of a digital signal processed with the predetermined digital computation.

46. The method according to Claim 43, wherein the first digital processing further comprises the step of limiting a signal band of a digital signal processed with  
5 the predetermined digital computation.

47. The method according to Claim 46, wherein the limiting step is pre-programmable.

10 48. The method according to Claim 43, wherein the second digital processing further comprises the step of setting a volume of a digital signal processed with the predetermined digital computation.

15 49. The method according to Claim 43, wherein the second digital processing further comprises the step of limiting a signal band of a digital signal processed with the predetermined digital computation.

20 50. The method according to Claim 49, wherein the limiting step is pre-programmable.

51. A method of mobile telecommunication using a semiconductor device, comprising the steps of:

first converting a voice input into an analog voice signal;

second converting the analog voice signal output from said converting step into a first digital voice signal;

5 first amplifying to output a second digital voice signal sampled with a predetermined voice sampling frequency for voice signals;

first generating a voice sound in accordance with the second digital voice signal output from said first  
10 amplifying step;

second amplifying to output a first digital audio signal sampled with a predetermined audio sampling frequency for audio signals;

second generating an audio sound in accordance with  
15 the first digital audio signal output from said second amplifying step,

wherein the semiconductor device is configured to process the first digital voice signal, the second digital voice signal sampled with the predetermined voice sampling  
20 frequency, and the first digital audio signal sampled with the predetermined audio sampling frequency, and comprising the steps of:

first converting the first digital audio signal into a second digital audio signal sampled with the

predetermined voice sampling frequency;

second converting the first digital voice signal into a signal sampled with the predetermined audio sampling frequency;

5 first digital processing of the second digital audio signal sampled with the predetermined voice sampling frequency and the second digital voice signal with a predetermined digital computation; and

10 second digital processing of the first digital voice signal sampled with the predetermined audio sampling frequency and the first digital audio signal sampled with the predetermined audio sampling frequency with the predetermined digital computation.